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SIGNAL DEVIATION WARNING SYSTEM

Filed July 24, 1950

2 Sheets-Sheet 1

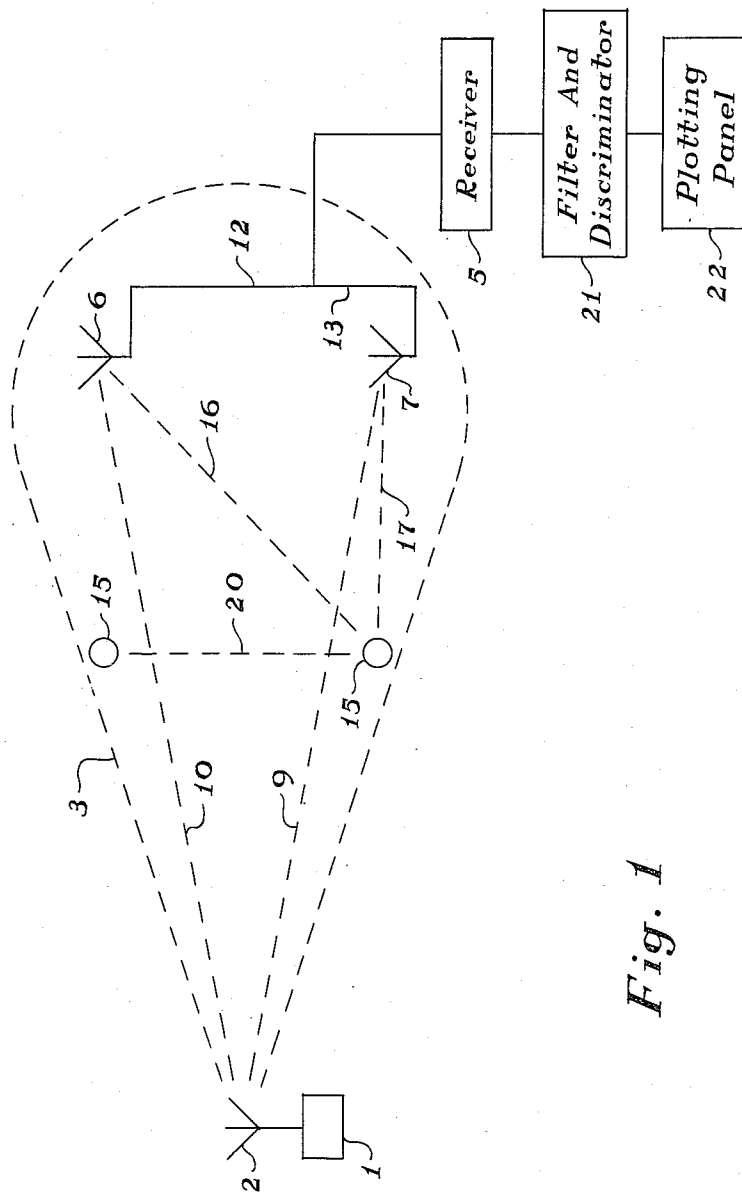


Fig. 1

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2 Sheets-Sheet 2

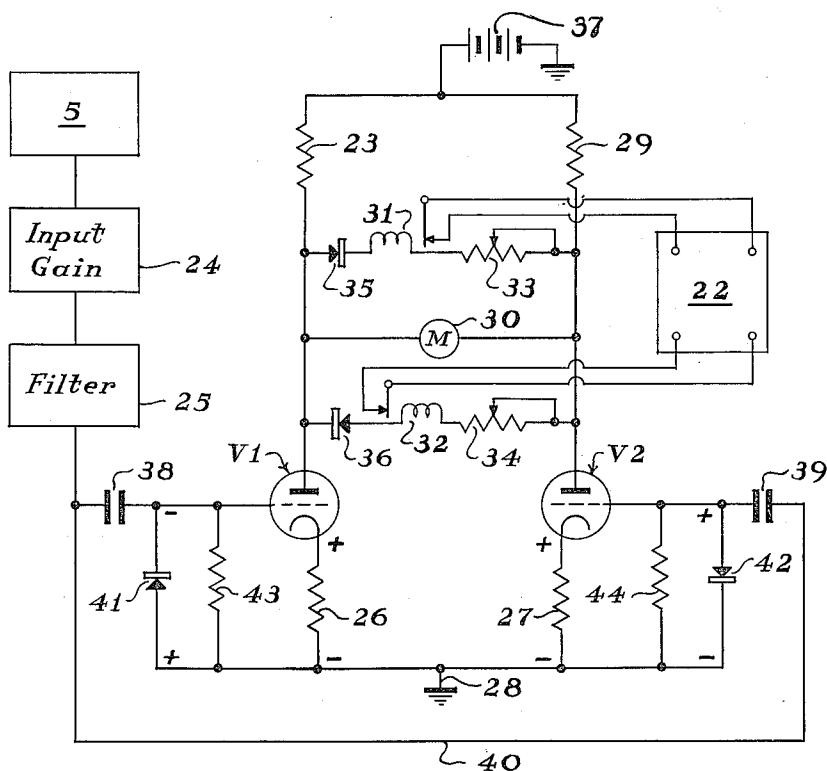


Fig. 2

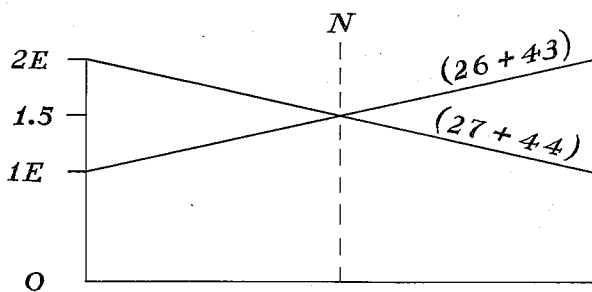


Fig. 3

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SIGNAL DEVIATION WARNING SYSTEM

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6 Claims. (Cl. 340—253)

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This invention relates to a sensitive detection or protective system capable of giving an alarm or warning upon the entrance or intrusion of anybody into a particular area or zone protected by the system. The system employs a radiation field of such directional characteristics and extent as to encompass the particular area to be protected or the field may be positioned to act as a barrier across any given opening such as a gate of a doorway or the like.

In recent years the need for sensitive, yet extremely reliable, protective or warning devices of the type referred to above has become extremely acute by reason of the need for maximum security protection in connection with various types of buildings and installations where the intrusion of unauthorized personnel must be guarded against and prevented. The system of the present invention is one which establishes the barrier or protective screen in the form of a radiation field produced by a transmitter and antenna transmitting a constant signal, the system embodying additional apparatus as will be described. Even a slight intrusion into the field such as the throwing of an object into the field will produce a signal or alarm at a central alarm station. The system, of course, will give an alarm in the event of a person walking into the field or a vehicle or the like intruding into the field. The presence of this detection system covering particular areas or zones or placed as a barrier across an entrance or the like is calculated to be unknown to intruders so that their presence can be detected before their being aware of it.

The system utilizes, in addition to the transmitter and antenna referred to above, a pair of similar antennas equally spaced from the transmitter antenna and connected to a receiver by coaxial lines which in terms of wave length of the transmitter are one-half wave length different in length; thus, if the receiving antennas are positioned and adjusted to receive signal at the same amplitude and phase, the signal will cancel. In practice the receiving antennas are adjusted so that there will be a certain amount of signal at the receiver for monitoring purposes. The result of this arrangement is that upon the intrusion of anybody into the radiation field, as the result of re-radiation from the body to the receiving antennas, which re-radiation will be along paths of different length to the receiving antennas there will be a change of signal at the receiving end of the system which is detectable and can be made to trigger an alarm system giving warning of the entrance of the body into the field.

In accordance with the foregoing the primary object of this invention is to provide a sensitive detection or warning system capable of giving a warning or signal upon the entrance or intrusion

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of anybody into a given protected zone or area or through a gate or entrance or the like.

Another object of the invention is to provide a detection system as in the foregoing comprising a transmitting antenna setting up a radiation field, a pair of similar antennas substantially equally spaced from the transmitting antenna in the field and connected to a receiver by coaxial lines which are one-half wave length different in length in terms of wave length of the transmitter whereby any signal transmitted normally cancels at the receiver but re-radiated signals from anybody intruding into the field produce a change in signal which is detectable at the receiver for purposes of triggering an alarm.

Another object of the invention is to provide a detection system as in the foregoing object wherein the receiver embodies a sensitive discriminator circuit for detecting a change in signal resulting from re-radiation embodying a normally balanced bridge circuit coupled to the receiver output so that any change in signal resulting from re-radiation unbalances the bridge, the unbalance of the bridge acting to trigger an alarm circuit.

Another object of the invention is an arrangement as in the foregoing object wherein the receiver output is coupled to the bridge as two opposite points and in such a way as to produce unbalance at both points which is cumulative with the result that the bridge circuit is extremely sensitive to any change in signal tending to produce unbalance.

Further objects and numerous advantages of the invention will become apparent from the following detailed description and annexed drawings wherein Figure 1 is a diagrammatic representation of the system showing the various antennas and an outline of the radiation field.

Figure 2 is a wiring diagram of the circuit of the detector or discriminator circuit.

Figure 3 is a graph illustrating the voltage relationships across two of the legs of the bridge which vary in opposite directions upon changing signal.

Referring to Figure 1 of the drawings, numeral 1 designates a conventional radio transmitter coupled to an antenna 2 which produces a radiation field having a pattern illustrated by the broken line 3 which represents the shape of the field in the horizontal plane. The radiation field is substantially cone shaped in both the horizontal and vertical planes.

Numeral 5 represents a radio receiver which is coupled to two receiving antennas 6 and 7 which, as shown are spaced at equal distances from the transmitting antenna 2 as indicated by the paths 9 and 10. The antennas 6 and 7 are coupled to the receiver 5 by coaxial lines 12 and 13 which are different in length, as shown, by

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the amount of one-half wave length in terms of wave length of the transmitter 1; that is, the coupling line 12 is one-half wave length longer than the coupling line 13. From the foregoing it will be observed that signals being sent to the receiver through the coupling lines one-half wave length different in length will cancel resulting in their being no output from the receiver, the antennas 6 and 7 being positioned and adjusted to receive signal at the same amplitude and phase from the transmitter 1. In practice, as will be pointed out, the antennas 6 and 7 are adjusted so that normally there will be a specific level of output from the receiver, this output being for purposes of monitoring the system. That is, in practice, any decrease in this normal signal level will be an indication of the failure of some part of the system, it being, of course, extremely important in this type of warning system that any failure of the system being promptly indicated so that corrective measures can be quickly taken.

Introduction or intrusion of a foreign or extraneous body into the field, for example, as at point 15, results in the body picking up signal from the antenna 2 and re-radiating this signal to a lesser degree, this re-radiated signal being along the paths as shown at 16 and 17 to the antennas 6 and 7 and as may be observed these re-radiated paths 16 and 17 to the antennas 6 and 7 are of different lengths. When the path lengths 16 and 17 are equal or different by one wave length as will readily be observed, the resultant signal to receiver 5 as a result of re-radiated signal will be zero. Also, as will be readily observed, when path lengths 16 and 17 are different by one-half wave length the signal to the receiver 5 resulting from re-radiation will be maximum. The initial wave length of the transmitter 1 is so selected that any foreign body moving across the radiation field in the direction of the line 20 will pass through several points of maximum and minimum re-radiated signal.

The radio frequency signal from the transmitter is modulated by a frequency which is detected by the receiver 5. Any change of signal level due to intrusion of a body into the radiation field is measured at the receiver output in terms of modulation frequency voltage. The receiver output is connected through a filter and discriminator or detecting circuit as shown at 21 to a centrally located alarm and monitoring station as indicated at point 22. The filter acts to eliminate any electric noise or disturbance present from outside sources at other than the desired frequency. The dual detector circuit detects any change in signal resulting from intrusion into the field of a foreign body.

Referring to Figure 2 of the drawings there is shown a wiring diagram of the detector circuit and also an input gain component 24 and filter 25. The detector circuit of Figure 2 comprises similar three element tubes, V1 and V2, in opposite legs of the bridge, these tubes having cathode resistors 26 and 27 which are connected together and to ground as shown at 28. The bridge has two similar legs in the form of resistors 23 and 29, these resistors being connected to the plates of the tubes V1 and V2 and the other ends of these resistors being connected. A plate voltage supply is provided in the form of battery 37. For detecting balance and unbalance of the bridge there is provided a galvanometer type of zero-center meter 30 which is

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connected between the plates of the tubes V1 and V2. Connected in parallel with the meter 30 are the windings of indicator relays 31 and 32; relay 31 operates upon increase in signal, as will be described, giving an indication of intrusion into the field; relay 32 operates upon decrease in signal to monitor the system; that is, to give an indication of reduction in signal to indicate equipment failure in some part of the system. The contacts of relays 31 and 32 are connected to indicators at the plotting station 22. Connected in series with the relays 31 and 32 are potentiometers 33 and 34 respectively which are adjustable to set the operating points of the relays 31 and 32. Numerals 35 and 36 designate rectifiers of detectors connected in series with the relays 31 and 32 respectively. Rectifiers 35 and 36 are so connected in polarity to operate relay 31 on an increase in signal and relay 32 on a decrease in signal.

The input to the detector circuit is coupled thereto through the condensers 38 and 39, condenser 39 being connected to the input through the wire 40 as shown. The condensers 38 and 39 are coupled to the grids of tubes V1 and V2 shunted by rectifiers 41 and 42 which are connected across the resistors 43 and 44 respectively and these resistors are connected as grid leaks as shown on the drawing. As shown the rectifiers 41 and 42 are directional such that the bias voltage developed with signal across 43 and 44 coupled to the grids of tubes V1 and V2 are positive and negative respectively as shown on the drawing. The voltage across 43 and 44 added to voltage across 26 and 27 form the effective tube bias denoted by E of Fig. 3. Resistors 26 and 27 are of such size that without signal on the system they develop a given ratio of voltage which, referring to Figure 3 of the drawings, may be represented by 1E and 2E respectively. As will be observed, therefore, without signal the unbalance of the bridge is maximum. With increasing signal input, the rectifiers 41 and 42 being directional as pointed out above the grid biases of tubes V1 and V2 decrease and increase respectively with the result that the voltage drop across resistors 26 and 27 increases and decreases respectively. More specifically the voltage drop across resistor 26 and resistor 43 increases towards 1.5 and the voltage drop across resistor 27 and resistor 44 decreases towards 1.5 and as will be observed from Figure 3 the bridge balances at only one particular point (N) at which the voltage drop across both the resistors 26 and 43 and 27 and 44 is 1.5E. The level of signal at which the bridge balances can, of course, be selected by the input gain control 24 and this signal level is measured by the meter 30. Particular values of voltage indicated of Figure 3, are, of course, merely exemplary. Any change in signal when the bridge is balanced will, of course, result in a current flowing through either the relay 31 or 32 determined by the direction of unbalance. As pointed out above unbalance in one direction will indicate intrusion into the radiation field and unbalance in the other direction will indicate a failure of some part of the equipment. From the foregoing it will be observed that in normal operation of the system the bridge is balanced at a sensitive balance point and that the bridge becomes unbalanced in one direction or the other and that unbalance in either direction gives an appropriate signal at the central station indicating either an intrusion or failure of

the equipment. It can be seen, therefore, that the system is of extremely positive and reliable type in that there is no opportunity for the system to get out of order and become ineffective without this being indicated to the operator at the control station and that during operation a disturbance of the radiation field is indicated at the central station as an intrusion.

The foregoing is representative of a preferred form of my invention and it is intended that such variations and modifications as may be made by those skilled in the art shall be covered by the claims appended hereto.

I claim:

1. In a discriminator circuit the combination of means forming a bridge circuit including a plurality of grid biased tubes having cathode resistors connected in opposing legs of the bridge, means including a signal input lead for coupling a signal input to the grids of each of said tubes, blocking condensers connected with each of said grids and with said signal input lead, and rectifiers connected with each of said grids and in shunt with each of said cathode resistors.

2. A circuit as claimed in claim 1, in which said rectifiers are so connected as to have opposite directional characteristics.

3. A circuit as claimed in claim 1, in which a resistor is connected in each of said bridge legs and with the plates of said tubes.

4. A discriminator circuit comprising the combination of means forming a bridge circuit with a pair of electrically adjacent legs each including a thermionic tube with grid, plate and cathode and a resistor in series with the cathode, a signal input lead operatively connected with the grids of each of said tubes for coupling a signal input to said grids, condensers connected in series with each of said grids and with said signal input

lead for coupling an input signal from the input lead to said grid and to rectifiers, rectifiers of opposite directional characteristics connected with each of said grids and with each other and with end portions of each of said cathode resistors remote from said cathodes, separate conductors and resistors connecting each of said tube plates with a power supply, a galvanometer type meter connected between said separate conductors intermediate said resistors and the plates of said tubes, a plurality of relays having windings connected between said separate conductors and in parallel with said meter, and rectifiers of opposite polarity connected in series with said relay windings to operate one relay on increase in signal and another relay on decrease in signal.

5. A circuit as claimed in claim 4, in which potentiometers are provided in series with each of said relays for selectively setting the operating points of the relays.

6. A circuit as claimed in claim 4, in which leads are connected with contacts of each of said relays and are adapted to be connected with indicator means at a remote location.

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